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Professional Culture of the Specialist of the Future

ON THE CONSTRUCTION OF THE HUMANITARIAN EDUCATIONAL PARADIGM OF THE FUTURE SPECIALIST

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Abstract

Currently, the accumulated experience can be used in thinking about how to design a humanitarian educational paradigm of the future specialist. All components of the paradigm, including axiological and ethical issues of activity in any profession, can be represented more adequately through the use of instrumental achievements of modern logic. It is necessary to pay attention to the "elective affinity", i.e. the close unity of the tools of logic and the tools of probability theory. The integrated educational paradigm must take into account the role of "all - pervasive", - everywhere and always present, - chance. In order to trace the "channels" through which chance affects our thinking, we can use some topological concepts and, above all, "manifold". Accordingly, the interaction of objects is a mapping of one "manifold" to another. Our mind is "multidimensional" ("multiple"), i.e. a manifold. The principles of "dimensional ontology", according to which the object and the subject matter of our thinking do not coincide, point to another possibility for the manifestation of the "ubiquitous" chance. The hypothetical-deductive method in conjunction with the method of diagnosis according to the Bayes is the most important metric tool in assessing the role of chance in cognitive and practical activities of any kind.

Keywords: Bayes' formula, chance, dimensional ontology, logic, paradigm, probability theory.

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1. Introduction

It is obvious that the humanitarian educational paradigm of a specialist in any field represents a certain *integration* of the socio-humanitarian paradigm and the corresponding "sectoral" (for example, technical) paradigm. The future specialist should be not only competent in the content of his specialty. It is necessary that he has the ability to plastically rebuild his "career path", using a wide range of sectoral skills and meta-competencies.

First of all, the level of meta-competence includes mastering by students the concept of "paradigm". Kuhn (1962, pp. 182-191), the founder of the idea of introducing the concept of paradigm into the philosophy of science, agreed that this concept is "fuzzy". The authors of the report use the concept of paradigm as "*disciplinary matrix*".

One important sort of components Kuhn labels "*symbolic generalizations*". He explains that the word "symbolic" is taken from the context of modern (symbolic) logic, and in this component the members of the scientific group include expressions, clothed in a logical form $(x)(y)(z)\ \Phi(x, y, z)$. These are laws discovered and studied further in the relevant field; for example, $F = ma$ (one of Newton's laws), $I = V/R$ (Ohm's law), or $H = RI^2$ (Joule-Lenz law). In other cases, natural language is used; for example, "elements combine in constant proportion by weight" or "action equals reaction".

The second type of components (Kuhn, 1962) calls them "*conceptual models*") includes the agreements-regulations recognized in the given scientific community.

The third component is "*values*". Compared to symbolic generalizations and conceptual models, they are more characteristic of a "sense of community as a whole" (Kuhn, 1962, pp.184-186). These are standards of research, development, evaluation criteria and choice of theories, application of the results, etc. "Probably the most deeply held values concern predictions: they should be accurate; quantitative predictions are preferable to qualitative ones" (Kuhn, 1962, p.185).

The fourth component is "*shared examples*" (Kuhn, 1962, pp.186-191). First of all, we mean those specific solutions to the problems faced by students from the very beginning of their scientific training in laboratories, exams or at the end of the chapters of their textbooks. To these shared examples should be added at least some of the technical problem-solutions found in the periodical literature that scientists encounter during their post-educational research careers and that also show them by example how their job is to be done. More than other sorts of components of the disciplinary matrix, differences between sets of exemplars provide the community fine-structure of science. As their training develops, the symbolic generalizations they share are increasingly illustrated by different exemplars.

2. Problem Statement

2.1. Since the establishment of the concept of paradigm by Kuhn, many concepts and statements relating to the process of obtaining and applying knowledge in *any* field have been "declared". So, according to the authors of this report, it is advisable to introduce them at the level of meta-competence of the humanitarian educational paradigm (Karavaev, 2015b).

2.2. It is obvious that at the level of meta-competence, the prepared specialist should clearly understand *the relationship of science and philosophy*, and in particular, the relationship of the scientific

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field in which he will work, and the philosophy of science. In fact, the philosophy always asks the same questions: about the world, about human life, about its meaning and purpose of a man of conscience, duty, etc., etc., - called, - not without reason - the *eternal*.

2.3. And every science deals with quite specific questions, which can be given quite specific answers. However, the solution of specific scientific problems by scientists essentially depends on the influence of philosophical ideas. And vice versa: it is easy to give an example of how important can be a scientific result not only for science but also for philosophy. So, in the "theory of optimal allocation of resources" of Kantorovich (2012) the concept "resource" is very close in content to philosophical concepts.

2.4. One of the biggest philosophers of the twentieth century (also having significant results in science – in mathematical logic), van Quine (1953, p.445) said: "… philosophy of science is philosophy enough". He meant that philosophers interested in ontological problems may well "find themselves" in the study of ontological problems of development and functioning of science; philosophers, gravitating to the development of ethical problems, will, apparently, interested in the problem of responsibility of the scientist, etc.

2.5. When constructing a humanitarian educational paradigm of the future specialist, taking into account the achievements of various sciences, philosophy and methodology of science, logic and mathematics, we should try to constantly improve its various components.

3. Research Questions

3.1. In the component formed by symbolic generalizations, it is now possible to use the achievements of modern non-classical logic: modal, temporal, epistemic, deontic, erotetic (logic of questions). Bearing in mind, for example, values and ethical issues, one can try to represent more adequately the subtleties of the axiological complexities of activity in *any* profession (Karavaev, 1998; Karavaev, 2006). You can try to do it in the components of conceptual models, values, and shared examples as well.

3.2. To explore further the possibilities of interaction of different sciences. After all, the known complex of knowledge (mathematics, logic, programming, physics, chemistry, materials science, etc.) now allows you to have a method of information modeling. In improving nuclear weapons, this method avoids so-called" field experiments", i.e. real nuclear explosions.

3.3. Belonging to the modern humanitarian educational paradigm should be "*elective affinity*", i.e. a close unity of the tools of logic and the tools of probability theory (Karavaev, 2015a).

3.4. According to the authors of the report, the integrated educational paradigm should more adequately represent the "*speculative theoretical level of knowledge*".

3.5. According to the authors of the report, the integrated educational paradigm must take into account the well-defined interest of the modern methodology of social sciences and Humanities (in particular, historical science and historiography), to the role of "all - pervasive", that is, everywhere and always present, - *chance* (Karavaev & Nikitin, 2017).

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4. Purpose of the Study

Basing on the compilation of relevant results (including those obtained by the authors of the report) and their philosophical, methodological and mathematical and logical analysis, to assess the current state and some issues of construction of the humanitarian educational paradigm of the future specialist.

5. Research Methods

5.1. Systematization of the relevant results (including the results obtained by the authors of the report) in the philosophy and methodology of science.

5.2. Construction and semantic validation of calculi of modal, temporal, deontic logic.

5.3. Construction of plausible reasonings.

5.4. Cognitive-psychological studies of people's perception of chance and its relation to causality.

5.5. Topological modeling of cognitive processes.

5.6. Bayesian diagnosis of the viability of the hypothesis.

6. Findings

6.1. It has been shown that that at least some of the difficulties in constructing deontic logic can be overcome by means of temporal qualification of the so-called “standard” model; all details are given in the publication (Karavaev, 2006).

The basic relation of temporal precedence is defined as a degree of an *elementary* relation $<'$ which is characterized by the following features: (i) irreflexivity; (ii) uniqueness of time quantum; (iii) infiniteness; (iv) treelikeness; (v) connectedness.

The definition of the degree of the relation $<'$ is the following:

(1) $x <^1 y$ if and only if (iff) $x <' y$

(2) $x <^n y$ iff $\exists v_1 \exists v_2 \ldots \exists v_{n-1} (x <' v_1 \,\&\, v_1 <' v_1 \,\&\, \ldots \,\&\, v_{n-1} <' y)$

We introduce a *complete* relation: $x < y$ iff $\exists n (x <^n y)$ and use the model $\Im_b = \langle T, < \rangle$ in which $T = \{x, y, z, \ldots\}$ is a basic (non-empty) set of “moments” and $<$ is a binary temporal relation. We introduce a relation of deontic alternativeness R_t: if $\alpha R_t \beta$ then $\alpha \cong_t \beta$, where $\alpha \cong_t \beta$ if and only if $\alpha(t') = \beta(t')$ for every $t' < t$ is a relation of “*historical identity*”.

The described tools allow us to consider even some delicate issues. For example, we can strictly prove such a rule: “Obligations imposed and accepted at present and pertinent to past events do not have any normative meaning”. So, “You ought (today) to present at yesterday’s meeting” does not mean much more than “May be, you presented at yesterday’s meeting”.

6.2. In the implementation of the "elective affinity" of logic and probability theory, we rely on G. Pólya’ pattern of *plausible inference* (Pólya, 1954, pp.4):

A implies ***B***

B true

A more credible

We can get a general pattern of plausible inference (Pólya, 1954, pp.8-9):

A implies B

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B very improbable in itself

B true

~~A very much more credible~~

Also this pattern appears as a modification of the fundamental inductive pattern; indeed, from the reverse side:

A implies B

B quite probable in itself

B true

~~A just a little more credible~~

The verification of a consequence counts more or less according as the consequence is more or less improbable in itself.

6.3**.** E.T. Jaynes (2003) put forward the idea of "*extended logic*" which researchers had been using at the early stages of discovery. Pólya demonstrated this qualitative agreement in such complete, exhaustive detail as to suggest that there must be more to it. Fortunately, the consistency theorems of R.T. Cox (1946) were enough to clinch matters; when one added Pólya's qualitative conditions to them the result was a proof that, if degrees of plausibility are represented by real numbers, then there is a uniquely determined set of quantitative rules for conducting inference. So, Jaynes formulated his concept as follows: *probability theory as extended logic*. The 'new' perception amounts to the recognition that the mathematical rules of probability theory are not merely rules for calculating frequencies of 'random variables'; they are also the unique consistent rules for conducting inference (i.e. plausible reasoning).

6.4**.** The concept of the "*speculative theoretical level of knowledge*" is introduced by an outstanding Russian philosopher Bransky (2005, pp.229-232). The history of theoretical physics strongly suggests that the original concepts of the new fundamental theory must not be obtained by simply inductive generalization of experimental data. It is also impossible to obtain - by means of deduction - from the old theoretical concepts. There is an activity of knowledge: the speculative nature of abstract theoretical concepts and "visible", from the point of view of our (macroscopic) experience, theoretical ideas are not limited to passive reflection of objective reality.

Let us recall one historical episode. In 1958 in New York at the Symposium on the theory of elementary particles after the speech of W. Pauli, in which he explained the new ideas formulated by him and W. Heisenberg, N. Bohr said something like the following:

"We all agree that your theory is crazy. The question that separates us is whether she is crazy enough to have any chance of being right. I have a feeling it is not enough crazy" (Dyson Freeman, p.80).

Some of the authors interpreted this figurative statement that the theory "does not seem right, if it is not "crazy enough", as a speech *against* logic. However, Bohr had in mind that the proposed theory must be significantly (up to "madness"!) different from the views of the current time. It is quite clear that the content of such differences cannot be distinguished *without* logic.

6.5. An extremely important place in the design of the humanitarian educational paradigm of the future specialist belongs to accounting the role of "all - pervasive", - everywhere and always present, - *chance*.

Scientists face this kind of situation in social philosophy when thinking about the sciences of management and planning. And this is natural: "designing the future" is based on our understanding of the present and the past, which were once the future. Accordingly, in the processes of thinking (including

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imagination) and in its results there is a chance that "adds up" with a chance that is present in all events reflected by our thinking. From the very beginning of the "construction of the future" (forecasting, strategic planning, design, scenario analysis, evaluation of long-term prospects of the actions taken, "foresight"), we must take into account the difficulties of statistical thinking.

In cognitive-psychological studies of people's perception of chance and its relation to causality fundamental results are obtained by jointly worked for over two decades (1972-1995) Kahneman and Tverski (Kahneman, 2011), and the results obtained by Taleb (the first decade of this century) (Taleb, 2004; 2007; 2012). These scientists have shown the amazing limitations of our minds: the over-confidence that we seem to know, and the apparent inability to adequately appreciate the "volume" of our ignorance.

Our natural and justifiable predilection for causal reasoning exposes us to serious mistakes in evaluating the randomness of truly chance events (Kahneman, p. 115).

From time to time, realizing *the uncertainty of the world around us*, we, however, tend to overestimate our understanding of the world and underestimate the role of chance in events. Our over-confidence "is fueled" by the *illusory certainty of looking back at the past*. We tend to overestimate the capabilities of our tools for the treatment of chance (for example, Markov processes or Monte-Carlo method). We "fool" ourselves (Taleb's expression) when we believe that the description of randomness presented with our tools fully covers objective chance.

From the point of view of the topic of the report and meta-competence issues, the authors appreciate the following statement made by Taleb. We do not spontaneously learn that *we don't learn that we don't learn.* The problem lies in the structure of our minds: we don't learn rules, just facts, and only facts (Taleb, 2007, p. *xxl*). *Metarules* (such as the rule that we have a tendency to not learn rules) we don't seem to be good at getting.

6.6. The authors of the report, specifying the "channels" through which chance affects our thinking, turned to the topological concept of "*manifold*". In the famous lecture "On the Hypotheses which Lie at the Bases of Geometry ", given at the University of Göttingen in 1854, B. Riemann formulated the general idea of "manifold", i.e. mathematical space, including functional and topological spaces (Riemann, 1998).

In considering the possibilities of the most systematic and complete account of the randomness present in the world and in our thinking, the authors of the report propose to use the concept of "manifold" as a common scientific concept. Any real object - both material and ideal nature - can be considered as "manifold", and, accordingly, the interaction of objects - as a *mapping* of one "manifold" to another.

Further, according to the concept of Gardner (Gardner, 2004), our mind is "*multidimensional*" ("multiple"), i.e. we can we can consider our mind as a Riemannian "manifold". It is possible to distinguish such the basic dimensions of mind: (1) linguistic; (2) logical-mathematical; (3) visual; (4) sound-musical; (5) body-kinesthetic; (6) intrapersonal; (7) interpersonal. These dimensions are the characteristics of a single whole – a *multidimensional mind*. Herewith, they are *orthogonal*, i.e. such that no measurement is reduced to any other dimension or to several others. Each person is characterized by a unique combination of more or less developed different dimensions of mind, and it is manifested in individual differences between people. The abilities of people of different cultures are different combinations of different types of intelligence. So, we can note one of the levels of manifestation of chance.

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Further, we turn to the principles of Frankl's "*dimensional ontology*" formulated by him in 1965 (Frankl, 1990, pp.45-47).

They allow us to trace the mapping of one manifold to another.

The first principle: *The same object* (for example, a cylinder) projected from its "life space" with a large number of dimensions into the "cognitive space" of the subject with a smaller number of dimensions can produce various objects (circle, rectangle).

The second principle: *Different objects* (e.g., cylinder, cone and ball) projected from their (common) "living space" with a large number of dimensions into the "cognitive space" of the subject with a smaller number of dimensions *can* produce the *same subject matters* (circle, circle, circle).

Obviously, analyzing both the content of the thinking process and its results, in terms of the manifestation of "ubiquitous" chance in both of them, one should consider the principles of Frankl. And this is true - and equally obviously - of the components of any paradigm, and not just belongs to their integration, but contributes to it.

6.7. According to the authors of the report, the integrated educational paradigm - especially in the components of "values" and "samples" - is based on the hypothetical-deductive method in conjunction with the *method of diagnosis by T. Bayes*.

It is *the most important metric tool* in assessing the role of chance in cognitive and practical activities of any kind. We will support this statement in more detail.

Let us have a set of hypotheses: $\boldsymbol{H_1}, \boldsymbol{H_2}, ..., \boldsymbol{H_n}$. *A priori* probabilities of their occurrence are known: $\boldsymbol{P(H_1)}, \boldsymbol{P(H_2)}, ..., \boldsymbol{P(H_n)}$. After a number of experiments $\boldsymbol{E}$, we change them to *a posteriori* probabilities: $\boldsymbol{P(H_1/E)}, \boldsymbol{P(H_2/E)}, ..., P(\boldsymbol{H_n/E})$.

The Bayes' formula can be considered as an optimal model for diagnosis:
$\boldsymbol{P(H_i/E) = P(H_i) \cdot P(E/H_i)/\Sigma P(H_i) \cdot P(E/H_i)}$, where $\boldsymbol{P(E/H_i) = P(E \cdot H_i)/P(H_i)}$;
here with $\boldsymbol{P(H_i) \neq 0}$, because otherwise $\boldsymbol{H_i}$ would be impossible; the sign $\boldsymbol{\Sigma}$ indicates a summation from i = 1 to i= n.

However, returning to the above about the "Black Swans", we keep ourselves from the absolutization of the Bayesian method for the reason that here we are not dealing with objective uncertainty, but with our *representations of it.*

7. Conclusion

Thus, the concept of "paradigm" proposed by T. Kuhn about 60 years ago remains useful and productive for understanding the process of development of the philosophy of science and training of scientists. Currently, the accumulated experience and many philosophical and methodological results can be used in thinking about how to design a humanitarian educational paradigm of the future specialist.

All components of the paradigm, including axiological and ethical issues of activity in any profession, can be represented more adequately through the use of instrumental achievements of modern logic and also the idea of "elective affinity" (a close unity of the tools of logic and the tools of probability theory). The integrated educational paradigm must take into account the well-defined interest of the modern methodology of social sciences and Humanities (in particular, historical science and historiography), to the role of "all - pervasive", - that is, everywhere and always present, - chance. In order to trace the "channels" through which chance affects our thinking, we can use some *topological tools* (first of all, the concept

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"manifold") and the principles of "dimensional ontology". The hypothetical-deductive method in conjunction with the method of diagnosis according to the Bayes is the most important *metric tool* in assessing the role of chance in cognitive and practical activities of any kind.

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